BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	)	
Facilitating Opportunities for Flexible, Efficient And Reliable Spectrum Use Employing Cognitive Radio Technologies	)	ET Docket No. 03-108
Authorization and Use of Software Defined Radios	)	ET Docket No. 00-47 (Terminated)

REPLY COMMENTS OF:

SPUTNIK, KILLIAN AND ASSOCIATES, DINWIDDIE ASSOCIATES, INC, W AND J PARTNERSHIP, RESILLENT, VISION CHAIN, INC., GIBEO LLC, NEOSOCIETY, DAMAGE STUDIOS, COHEN SOFTWARE CONSULTING, INC, AEREAL, INC., LULU ENTERPRISES, INC., STONEBRICK GROUP, WIFINDER, INC., FEEDSTER, DANDIN GROUP, BERG SOFTWARE DESIGN, TOPDOWN DESIGN ASSOCIATES, BLOOTECH, INC, COUGHLIN ASSOCIATES, WHIZSPARK CORPORATION, BLOSSOM RESEARCH, LAUNCHSQUAD LLC, DO SIMPLE THINGS WELL, AND CEDX CORPORATION ("THE TECHNOLOGY COMPANIES")

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June 1, 2004

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Sputnik, Killian And Associates, Dinwiddie Associates, Inc, W and J Partnership, Resillent, Vision Chain, Inc., Gibeo LLC, Neosociety, Damage Studios, Cohen Software Consulting, Inc, Aereal, Inc., Lulu Enterprises, Inc., Stonebrick Group, WiFinder, Inc., Feedster, Dandin Group, Berg Software Design, Topdown Design Associates, Blootech, Inc, Coughlin Associates, WhizSpark Corporation, Blossom Research, LaunchSquad LLC, Do Simple Things Well, and CEDX Corporation hereby submit these reply comments in connection with the Commission's *Notice of Proposed Rulemaking and Order In the Matter of Facilitating Opportunities for Flexible, Efficient, And Reliable Spectrum Use Employing Cognitive Radio Technologies,* ET Docket No. 03-108 (Dec. 30, 2003) ("*NPRM*") in the above-captioned proceeding.[1]

[1] Center for Internet and Society summer intern Joseph Gratz assisted in the preparation of these comments.

I. INTRODUCTION

In our first response to the Commission regarding its proposals for facilitating use of cognitive radio devices, we identified five significant problems and offered four components to add to correct them.[2] We noted that the direction the Commission adopted – increasing opportunities to deploy and test smart devices—was correct, but the means — allowing specific technologies to be deployed in specific bands, in limited geographical areas, and in micro-regulated ways—would be devastating to innovation and to the software industry. As companies eager to pursue research and development in cognitive radio techniques, the Commission's proposals failed to provide the opportunities for innovation we hoped for. We urged the Commission to use this rulemaking to lay out a strategy and timeline for converting to a 'commons' based approach for spectrum management where heuristic devices increase spectral-efficiency without creating harmful interference. We also urged the Commission to continue to increase the amount of unlicensed spectrum available.

The primary focus of this reply is to counter the arguments made by the incumbent licensees, who argue both that cognitive radio is a pipe dream and that they are the party best situated to develop it, and that if the Commission implements any of the proposals in the NPRM, the licensees will purposely delay deploying spectrally-efficient technologies so they can protect themselves against competition. Given their reaction, we repeat and redouble our support for a sensible transition plan for spectrum management that will disentangle the development of cognitive radio techniques from the interests of the incumbent licensees.

We propose a three-part plan: first, increase opportunities for thirds parties to use and deploy smart devices across all bands, as long as they create no harmful interference and obey rules that the Commission develops; second, issue requirements and deadlines for incumbents to deploy transmitters that reflect state of the art spectral efficiency; and third, commit to leaving half the analog TV spectrum for unlicensed use when the digital conversion occurs. Given the Commission's mandate to manage the spectrum to maximize the marketplace of ideas, and the incumbents' stated intention to purposely avoid technologies that allow competition, we believe these are appropriate areas for effective agency rulemaking.

Further, these proposals are in line with proposals outlined in a GAO Report on spectrum efficiency released last week, which acknowledged the promise of cognitive radio:

> As software-defined radios become more sophisticated, the challenge in employing them will become even greater. For example, software-defined cognitive radios—radios that adapt their use of the spectrum to the real-time conditions of their operating environments—could be used to sense unused frequencies, or "white spaces," and automatically make use of those frequencies. According to FCC, many portions of the

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[2] *See* Comments of The Technology Companies.

> radio spectrum are not in use for significant periods of time and that tapping into these white spaces—both temporal and geographic—could significantly increase spectrum available for use. It may also be possible to use software-defined cognitive radios to exploit "gray spaces" in the spectrum—areas where emissions exist but that could accommodate additional users without raising the overall noise level in a band to a level unacceptable to incumbent users—to increase spectrum efficiency.[3]

Despite this capability, the report found that, "[t]he current structure and management of spectrum use in the United States does not encourage the development and use of some spectrum efficient technologies."[4] It (among other recommendations) proposes that the FCC take three specific steps: build more flexibility into the spectrum allocation system, encourage government agencies to use spectrum more efficiently, and increase opportunities for research and development on cognitive radio techniques.[5]

Like the GAO's recommendations, our three proposals will provide the strongest incentive for investment and innovation in cognitive radio. This incentive will stimulate the increased efficiency that the Commission's Spectrum Task Force and Technological Advisory Council, now joined by the GAO, agrees is possible. In contrast, as the GAO report recognizes, limiting innovation opportunities to certain locations, bands, or technologies is the wrong approach.

> While emerging technologies that use wider segments of spectrum or move across segments of spectrum may be able to operate within current demarcations, greater efficiencies may be achievable if these technologies were allowed to operate in an environment that provides more operational freedom than the current structure.[6]

To best facilitate innovation, the FCC should specify requirements that can only be reached by development and deployment of radios that are aware of their environment and react and respond to it in cooperation with other radios and systems, instead of issuing technological mandates as laid out in the NPRM. Allowing non-interfering uses of spectrum by all third parties opens the door to a much broader scope of innovative possibilities. For example, the Commission might allow use of cognitive radios that acquire information about legacy systems operating in their vicinity and operate in such a way that they do not cause those legacy systems to malfunction. This could include sensing transmissions from deployed radios and incorporating information about current transmission status provided by licensees to the FCC.

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[3] GAO Report at 19.

[4] *Id*.

[5] United States General Accounting Office, *Spectrum Management: Better Knowledge Needed to Take Advantage of Technologies That May Improve Spectrum Efficiency* (May, 2004) (GAO-04-666).

[6] GAO Report at 21

Such an arrangement would promote research that is currently not financially viable because the start-up cost to obtain spectrum for testing is unavailable.

The only parties that dispute the potential of cognitive radio are the spectrum licensees, who are currently the only parties with access to the spectrum needed to research and develop cognitive radio. This is an irony that the Commission needs to act to correct. Opening the door to the broadest scope of research possibilities will help spur the American software industry's growth in this field, provide the greatest breadth of services for consumers, and the most speech opportunities for citizens.

II. RESPONSES TO COMMENTS

Responses to the NPRM provide a roadmap for issues the Commission should clarify in any final rule on cognitive radio.

A. The Purpose of This Proceeding is Not To Expand the Scope of Licensees' Rights.

A number of comments raise questions regarding the scope of the rights granted to current licensees.[7] The position of the incumbents, as might be expected, is that their spectrum license includes all property rights, including the right to exclude any user not explicitly authorized by the licensee. For example, the Wireless Communications Association International calls this rulemaking "a vehicle for forcing licensees of such services to share their spectrum with unlicensed users or anyone else," and claims the Commission has "no legitimate justification" for doing so.[8]

In the first part of the NPRM, the Commission lays out a compelling justification for its proposed action, documenting the evidence to date that current technology coupled with the promise of effective cognitive radio techniques can radically increase the non-interfering uses of spectrum. Based on this, the Commission's authority to provide opportunities to test this evidence by allowing non-interfering secondary use of the spectrum is sound, and, in fact, may be constitutionally required where the Commission finds that such use will increase the amount of speech that the spectrum can support. In upholding the Communications Act of 1934 against a First Amendment challenge, Justice Frankfurter wrote:

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[7] *See, e.g.*, Comments of Access Spectrum, LLC a spectrum leasing company, at 4 (asking the Commission to "clarify that licensees have full control over who has access to their spectrum"); Comments of Verizon Wireless at 8 (characterizing the Commission's proposal as "invading licensee rights"); Comments of Nextel Partners at 5-6 (urging that, "[t]he Commission should make it clear in any rules promulgated to facilitate introduction of CR and SDR that they may not operate in bands dedicated to CMRS licensees, except when utilized by, or with the express advance written permission of, the existing licensee").

[8] Comments of Wireless Communications Association International at 4.

> Freedom of utterance is abridged to many who wish to use the limited facilities of radio. Unlike other modes of expression, radio inherently is not available to all. That is its unique characteristic, and that is why, unlike other modes of expression, it is subject to governmental regulation. Because it cannot be used by all, some who wish to use it must be denied.[9]

It follows that when technology makes it possible for radio to be used by all, none who wish to use it may constitutionally be denied. This view was reinforced twenty years later in *Red Lion*, where the Court noted that:

> Because of the scarcity of radio frequencies, the Government is permitted to put restraints on licensees in favor of others whose views should be expressed on this unique medium. But the people as a whole retain their interest in free speech by radio and their collective right to have the medium function consistently with the ends and purposes of the First Amendment.[10]

The collective right of "the people as a whole" to use the spectrum consistently with First Amendment principles must, therefore, be the guiding principle behind the Commission's regulations in this area, since it is the source of it's authority to regulate spectrum allocation.

As the incumbents point out,[11] the spectre of competition from new entrants using cognitive radio may take away licensees' incentives to use spectrum efficiently. This only bolsters the Commission's authority to promote cognitive radio deployment—its power to act is strongest where the market creates economic incentives to stifle speech.

Further, we share the view expressed by the Shared Spectrum Company that:

> Existing licensees do not, and should not, own the spectrum they use. They are merely given the right to use the spectrum in ways limited by frequency, location, and time and exclude other services only to the extent that such services may cause them harmful interference. Allowing secondary use must not be the occasion for enlarging their legal rights to comprise what essentially would be the ownership clearly forbidden by the

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[9] Nat'l Broad. Co. v. U.S., 319 U.S. 190, 226 (1943)

[10] Red Lion Broad. Co. v. FCC, 395 U.S. 367, 390 (1969).

[11] *See, e.g.*, Comments of Cellular Telecommunications and Internet Association at 6 (arguing that the introduction of underlays would have the "effect of weakening CMRS licensees' incentives to make more efficient use of their licensed spectrum"); Comments of Verizon Wireless at 8-9 (arguing that "licensees will have little if any incentive to deploy spectrally efficient technologies," since "any future increases in a *licensed user's* efficiency yield benefits for the *unlicensed* users of the band.").

> Communications Act and sound public policy. Nothing will thwart a new technology more effectively than giving exclusive control over it to entrenched parties already providing services in the same field.[12]

The incumbent licensees were never granted nor sold the full bundle of property rights that they claim in their comments in this proceeding, and it should not be hijacked by them to reinforce their false claims. It is not the Commission's role to shore up incumbents' business interests at the expense of development of a new technology, especially where the incumbents' complaint is that the new technology may cause them to face more vigorous competition.

Their belief is mistaken-- that by allowing use of cognitive radio in licensed bands, the Commission is coming up with new ways to slice the existing spectrum pie, taking pieces away from licensees and giving them to unlicensed users. They fail to acknowledge that cognitive radio technology enlarges the entire pie. The Commission takes nothing away from incumbent users by allowing unlicensed use of newly-available bandwidth made usable by cognitive radio.

Court decisions cited by the Wireless Communications Association International that discuss post-hoc changes in government auctions have no bearing on this rulemaking.[13] The Commission is not proposing a change to the rules once the game has already begun. First, the Cognitive Radio proposal does not change the interference protection rights of licensees. Licensees are still protected from harmful interference that prevents their effective use of licensed spectrum. Second, in the *U.S. AirWaves* case cited by the Wireless Communications Association International,[14] a disappointed bidder sued the FCC because the financial terms of the auction were, in the end, more favorable than the announced terms he had relied upon when bidding. The FCC proposes no change to the financial terms of past auctions or to the rights granted to the licensees as a result of those auctions. The right at issue here – namely, the right to *exclusive* use of certain frequencies – is a right outside the scope of the licenses granted at auction, which allow transmissions on certain frequencies, at certain power levels, in certain places, free from harmful interference.

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[12] Comments of Shared Spectrum Company at 4.

[13] See Comments of Wireless Communications Association International at 10. ("Certainly, any *post hoc* mechanism for imposing mandatory sharing of licensed spectrum must be squared with the interference protection rights and freedom to innovate that licensees have spent billions for in acquiring spectrum through secondary market transactions and/or the Commission's auction process. Regarding the later [sic], the D.C. Circuit "start[s] from the intuitive premise that an agency cannot, in fairness, radically change the terms of an auction after the fact," and has confirmed that "a bidder in a government auction has a 'right to a legally valid procurement process'; a party allegedly deprived of this right asserts a cognizable injury." It is also clear that post-auction decisions that defeat the auction process are actionable, even where the auction itself was conducted properly – as the D.C. Circuit has noted, "[t]here is no basis for suggesting . . . that *ex post* changes can never affect the validity of a government auction.")

[14] U.S. AirWaves, Inc. v. FCC, 232 F.3d 227 (D.C. Cir. 2000).

Finally, it is particularly ironic that an association of wireless companies is pointing to its large sunk costs to discourage the FCC from allowing new entrants in its market. Incumbent local wireline telephone companies made the very same arguments when new entrants, including some members of the WCA, sought access to unbundled network elements at TELRIC rates.[15]

B. The Objectives of The Commission's Spectrum Management Role Will Be Advanced By Promoting Expansive Cognitive Radio Deployment.

Cingular Wireless argues:

> The Commission's spectrum management responsibilities comprise multiple objectives, including interference prevention, allocation of spectrum to meet demand consistent with the public interest, and promotion of efficient spectrum use. Allowing un-licensed access to licensed CMRS, MMDS, and WCS spectrum through the use of cognitive radio technologies will further none of these objectives.[16]

While we might phrase it differently, we do not differ with Cingular's statement of the Commission's spectrum management responsibilities. However we believe allowing cognitive radio to operate in licensed areas furthers all of these spectrum management objectives.

First, the purpose of the Commission's interference prevention mandate is to promote the most speech, not to maximize the speech opportunities for incumbents. Effective cognitive radio technology will not harmfully interfere with other spectrum uses. The promise of smart radios is that they can learn from their environment how to maximize the efficient use of the spectrum. Promotion of cognitive radio by the Commission furthers the goal of interference prevention by encouraging the adoption of devices that decide how to prevent harmful interference with their transmissions. Unlicensed users under a strict mandate not to interfere with primary users will have the greatest incentive to develop the software that makes this possible.

Second, the Commission best fulfills its responsibility to allocate spectrum in the public interest by allowing unlicensed, non-interfering underlay use of licensed spectrum. This allocation is in the public interest because it furthers the public's First Amendment interests, making more bandwidth available to more speakers without interfering with existing uses. User-by-user, band-by-band allocation is not necessary for cognitive radio applications, since the radios transmit only on unused portions of spectrum, effectively allocating rights among themselves in real time.

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[15] *See, e.g.*, AT&T Corp v. Iowa Utilities Bd., 525 U.S. 366 (1999).

[16] Comments of Cingular Wireless at 10.

C. Innovation and Competition Are Best Promoted By Enabling Non-Interfering Uses of All Spectrum.

The incumbent licensees argue that, to the extent increasing spectrum efficiency is a valid objective for the Commission, it is best achieved by increasing the control licensees have over their licensed frequencies.[17] Because they can financially benefit by leasing the spectrum to third parties, the argument goes, they have the greatest incentive to develop technologies to facilitate growth of the secondary market. For example, the Cellular Telecommunications and Internet Association argues that, "[i]f underlay operations prove to be technically feasible and economically efficient, licensees in a competitive market like CMRS have the economic incentive to lease spectrum usage rights and maximize revenue."[18]

This argument presupposes that incumbent licensees' incentives derive solely from potential leasing fees. It fails to account for their economic incentive to prevent new entrants into their markets. The incumbents currently enjoy the monopoly rents that come from monopoly control of their frequencies. They are unlikely to lease spectrum usage rights to companies offering innovative new services that compete with their existing services at a price that new entrants could afford. Thus their incentive to innovate is limited to devices that could create additional efficiency within their leased spectrum and to devices that allow non-competing uses of the spectrum.

Further, the incumbent's ask the Commission to protect them from competition. Access Spectrum, LLC writes that "[a]llowing unlicensed operators to use this same spectrum for *free* to provide a competitive service will seriously jeopardize the business pursuits of those who have participated in a public auction to secure access to exclusive spectrum."[19] We do not believe that protecting incumbents' monopoly power over their spectrum is a valid goal for this rulemaking. But even if harm to the incumbents' profits were to be considered, the extremely moderate step the Commission proposes here—allowing unlicensed operators limited access, in limited bands, at limited radiated energy, for non-interfering uses—poses no such threat. Instead, it provides an extremely limited testbed for experimenting on cognitive radio techniques to companies who otherwise would not be able to invest the upfront costs necessary to enter the market.[20]

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[17] *See, e.g.*, Comments of Verizon Wireless at 9-10 ("To establish a functioning secondary spectrum market, the Commission must give licensees control over third-party opportunistic devices in their licensed spectrum. The concept of allowing unlicensed cognitive radios to transmit in licensed bands conflicts with one of the goals of the secondary markets initiative. A licensee facing greater interference from unlicensed transmitters will have less incentive and ability to resell spectrum. As a prospective lessee, why pay for rights to use spectrum that can be exploited for free or when Commission sharing decisions may render the space crowded?")

[18] Comments of Cellular Telecommunications and Internet Association at 8.

[19] Comments of Access Spectrum, LLC at 4.

[20] In fact, as we stated in our original comments, we believe this testbed is so limited as to be ineffective for testing many of the most promising cognitive radio techniques.

The incumbents' response to this extremely limited testbed is to advise that they will use their monopoly power to impede the Commission's efforts. Given the important speech interests at stake, the market failure that they threaten— licensees having "little if any incentive to deploy spectrally efficient technologies if an underlay or easement is not under the licensee's control, since any future increases in a *licensed user's* efficiency yield benefits for the *unlicensed* users in the band"[21] —is an appropriate trigger for Commission intervention. As we described above, it is not enough for the Commission to allow non-interfering uses of licensed bands. It should also mandate that current licensees take steps to deploy technologies that maximize spectrum efficiency. This mandate would remain throughout the transition period until cognitive radio techniques are proven, and market influences driven by the eliminated scarcity problem prove sufficient to incent the incumbents to adapt their businesses to new allocation models without a government mandate.

The incumbent licensees themselves recognize that this Rulemaking is about competition, particularly whether the Commission plans to level the playing field so that newcomers can harness the wireless infrastructure to compete.[22] It appears their intention is to fight off any openings for competition, and to deny that competition leads to innovation. Many are familiar with these arguments from similar debates over whether monopoly provision of long-distance services spurred or stymied innovation. More recently, we point the Commission to the salutary, leveling effect that competition has had in the internet arena, where new entry by companies like Amazon.com has led to innovation by pre-existing bricks-and-mortar retailers like Barnes and Noble.

While cognitive radio is a new technology, the potential for increased spectrum efficiency from smart radios and for new high-value services is great. The dot-com boom demonstrated the extraordinary innovation opportunities that can stem from an architecture that permits garage innovators to develop and deploy services and the market to determine the winners and losers. Instead, the licensees would have the Commission determine, before the game has even begun, that the economic value of the services the licensees provide outweighs the potential value that will be provided by new entrants.[23] A final rule that both increases

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[21] Comments of Verizon Wireless at 8-9.

[22] Comments of Cingular Wireless at 11 ("[C]ognitive-radio-based sharing poses an economic tradeoff between known goods and services, highly valued by the consumers and producers who utilize them, and a speculative set of goods and services, whose identity is unknown and whose economic value and successful realization are unknown.").

[23] *See, e.g.*, Comments of Verizon Wireless at 6-7 ("The Commission proposes to invade licensed bands for the benefit of other businesses, specifically asking whether its proposed higher levels of power operation 'are sufficient to be of benefit to WISPs, wireless LANs or other unlicensed operations in areas with limited spectrum use.' The Commission itself makes no finding that these WLANs or WISPs will produce economic value comparable to that of the licensees who currently use the spectrum, or cannot use current unlicensed bands or bid at auction for new licenses.").

opportunities for non-interfering uses of licensed spectrum and increases incumbents' obligations to deploy spectrally-efficient technologies will provide a testing ground for healthy competition without degrading the existing level of service to consumers.

This is the win-win approach, as under this regime, the market-based incentives to implement spectrally-efficient technologies that licensees currently have will remain. Verizon points to its deployment of CDMA, a spectrally-efficient technology, to demonstrate its intent to pursue cognitive radio techniques absent any Commission action to date.[24] Its research was motivated by a business decision to serve more customers in the same amount of spectrum. V-Comm, hired by Verizon to file comments in this proceeding, recognizes that growth drives spectral efficiency:

> The operator has the incentive to improve spectral efficiency because the network will reap the benefits of any such improvement by allowing the operator to increase capacity, quality and coverage – in other words, to grow.[25]

There is no reason to believe this type of incentive will disappear if the Commission acts to counterbalance the anti-competitive incentives also described by the licensees.

D. Cognitive Radio Techniques Are Ready for Limited Deployment.

A number of organizations questioned whether the technology was ready for deployment, particularly as applied to public safety bands.[26] We have no interest in deploying technologies that may risk lives, though we question the premise that cognitive radio, properly implemented, poses risks when operated in public safety bands. But even if they are correct, there still remains the question of how to best spur innovation in these bands, where innovation is desperately needed. The promise of techniques like mesh networks—whose utility increases where use density is highest—may be particularly useful for increasing the effectiveness of public safety wireless use in urban areas, where the need is greatest.[27]

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[24] Comments of Verizon Wireless at 3.

[25] Comments of V-Comm at 6.

[26] *See, e.g.*, Comments of National Public Safety Telecommuncations Council at 5 ("[A]ny potential benefits of these new technologies will be negated if they are implemented without a high degree of caution and consideration, such that existing public safety systems and other spectrum users are subjected to or even threatened by the risk of interference to operational systems.").

[27] *See* Comments of Association of Public Safety Communications Officials at 3-4. ("[S]pectrum shortages in urban areas are such that public safety radio systems are much less likely than rural areas to have significant low use periods during which leasing would be viable. Urban systems tend to be overburdened with insufficient capacity for their own needs, let alone "excess" capacity to lease. Yet, the presumed market for interruptible spectrum leasing will be greatest in those same urban areas, where *non*-interruptible commercial spectrum from existing sources is unavailable.").

Treating public safety bands differently during the transition period may be appropriate. In the long term, teaching cognitive radios to treat public safety information differently may be appropriate. However, completely exempting public safety bands from the reevaluation that comes from introduction of cognitive radio techniques is not necessary.

As to the feasibility of cognitive radio more generally, the incumbents are united in their skepticism.[28] This attitude remains despite evidence from many technical bodies, including the Commission's Spectrum Task Force,[29] its Technological Advisory Council[30] and now the GAO.[31] This is a fertile ground for software companies to plow and for an industry anxious to ride the next innovation wave, wireless is a seductive target. That the incumbents speculate that it may not come to pass cannot be a reason for the Commission to regulate it out of existence, especially when the regulation specifically prohibits interference with the incumbents' current services.

E. The Commission Should Abandon Software Licensing Requirements.

The Commission must relax its requirement that SDR software be filed. First, as we stated in our comments, the hallmark of smart radio is that it adapts to its environment. The software routines are constantly rewritten to accommodate the local environment. A software licensing requirement, given this paradigm, is impracticable.

Also, we agree with Intel that "current rules provide adequate safeguards against unauthorized modifications to Software Defined Radios (SDR). A mandatory filing requirement could retard the deployment of SDR and unnecessarily burden the industry by restricting the use

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[28] *See, e.g.*, Comments of Cingular Wireless at 7 ("Throughout the *NPRM,* the Commission suggests that unlicensed use of licensed bands will be no problem as long as cognitive radios are used. It is entirely premature, however, to assume that there will be no problems, given that no cognitive radios designed to coexist autonomously (*i.e.,* not under central control) with spectrum-intensive services such as cellular and PCS yet exist, nor, as some would contend, is it possible."); Comments of Wireless Communications Association International at 2 ("The forced sharing idea, at least as it applies to services where receivers are mobile, portable or at fixed locations that are not a matter of public record and thus not knowable to cognitive radios, is based on a false premise, *i.e.*, that a cognitive radio is capable of accurately evaluating the condition of the radiofrequency environment of the licensed receivers it is required to protect.").

[29] *See* FCC Spectrum Policy Task Force, *FCC Spectrum Policy Task Force Report* at 71(Nov. 2002) (ET Docket No. 02-135) (recommending that the Commission make implementation of cognitive radio a policy goal).

[30] *See, e.g.*, FCC Technological Advisory Council II, *Report: First Meeting* at 10, *available at* http://www.fcc.gov/oet/tac/TACII_report6.pdf.

[31] *See* United States General Accounting Office, *Spectrum Management: Better Knowledge Needed to Take Advantage of Technologies That May Improve Spectrum Efficiency* (May, 2004) (GAO-04-666).

of an efficient manufacturing technique."[32] A registration requirement will have a particularly devastating effect on open source projects, prohibiting developers from participating in this new market. As the Electronic Frontier Foundation notes in its comments,[33] a cooperative, worldwide open source software project called GNU Radio has already succeeded in creating a software-defined radio that can, using commodity consumer hardware coupled with high-speed ADCs, perform such difficult tasks as demodulating an ATSC signal. In recent years, a great deal of innovation in the software industry has been spurred by competition from and cooperation with open-source software developers. The Commission should allow the open-source software community to participate in and assist with the technological possibilities brought on by cognitive radio.

There is no need for a licensing requirement to control rogue devices. Existing enforcement mechanisms and peer enforcement can address this concern. The market needs the freedom to develop at the pace of software—and that is well beyond the pace of rulemaking or licensing. This freedom requires the ability to develop and market DACs.[34] Whether in the licensed or unlicensed bands,[35] enforcement is the appropriate approach for ensuring compliance with Commission regulations.

For these reasons, we oppose any technical mandates and any limitations on the freedom to innovate. We join with Ericsson Corporation in their position that "adopting rules that promote a specific cognitive technology at this time may unintentionally favor that technology over another, hindering full deployment of competing technologies."[36] As we discussed in our original filing, limiting research opportunities will be devastating to the software industry, and will produce results antithetical to the purposes of this rulemaking.

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[32] Comments of Intel Corporation at 3.

[33] *See* Comments of Electronic Frontier Foundation at 4-5.

[34] "Intel strongly opposes any restriction on the mass marketing of high-speed DACs such as limiting marketing to commercial, industrial and business users as required for Class A digital devices. These devices do not represent a risk and such a restriction would represent a dangerous expansion of the regulation of the PC industry." Comments of Intel Corporation at 7.

[35] "In unlicensed bands, however, the Commission must require standards and must require testing to ensure compliance with the standard. Unlicensed devices not under common control of a licensee nor traceable through a Commission license are difficult to remove from use once deployed." Comments of Verizon Wireless at 11.

[36] Comments of Ericsson Corporation at 2.

III. CONCLUSION

We thank you for the opportunity to comment, and respectfully ask that the Commission take these and our prior comments into account as it develops its final rule. We would be happy to meet with you and your staff to discuss more specifically the impact the proposals might have on our businesses, and how the alternatives we propose might better stimulate the technology industry to accelerate cognitive radio development and deployment.

APPENDIX: LIST OF COMMENTERS

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